International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 1, Feb 2018, 757-762

DESIGN AND ANALYSIS OF STEAM TURBINE BLADE

A. PONSHANMUGAKUMAR[1] & R. RAJAVEL[2]

[1]*Research Scholar, Department of Mechanical Engineering, AMET University, Chennai, Tamil Nadu, India*

[2]*Department of Mechanical Engineering AMET University, Chennai, Tamil Nadu, India*

ABSTRACT

Steam turbine changes over the warmth vitality of steam into helpful work. Steam planes strike the moving columns of sharp edges mounted on rotor causes alter the course of steam which grants energy. In this manner, tapered boundaries change over the ongoing vitality of steam into the rotational dynamism of shaft. Moving sides in a turbine are stacked by radial powers and steam strengths. Contingent on the plan and working conditions, the radial constraint may create tractable, compressive or torsional worries in moving edge. Steam turbines are subjected to the number of new companies and close downs amid its life expectancy. That implies it is subjected to tedious cyclic stacking conditions which cause a weariness disappointment of moving cutting edges. This venture outlines auxiliary execution of the cutting edge because of divergent stacking that follows up on the side because of high precise rates. Additionally, weariness or administration life of sharp edge is assessed.

KEYWORDS: Steam Strengths, Torsional Worries & Sharp Edge is Assessed

Received: Oct 05, 2017; **Accepted:** Oct 25, 2017; **Published:** Jan 23, 2018; **Paper Id.:** IJMPERDFEB201883

Original Article

INTRODUCTION

In this review, first strain-controlled disfigurement and exhaustion life are computed for Stem turbine cutting edge, and afterwards, they are contrasted, and ANSYS comes about.[6-7] Different ways to deal with assessing mean anxiety impacts on the strain-life investigation are Morrow strategy and Smith, Watson, and Topper (SWT) technique utilised here to gauge the weakness life of steam turbine sharp edge.[8-10] Morrow employing the genuine crack quality is an extensive change. Be that as it may, the Morrow expression utilising the weakness quality coefficient ζf' might be non-moderate for metals other than steels.[10-12] The Smith, Watson, and Topper (SWT) strategy is a sensible decision that keeps away from the troubles. A steam turbine is a gadget that concentrates warm vitality from pressurised steam and uses it to do mechanical work on a turning yield shaft. For this situation, the weight and stream of vapour quickly turn the rotor.[13-14] The spouts and stomachs in a turbine are intended to coordinate the steam stream into very much shaped, fast flies as the steam grows from channel to fumes weight. Mechanical, Thermal, Linear and Nonlinear optical properties of Barium L-Tartrate single crystal described the non-linear properties of the systems. The pivoting sharp edges change over the motor vitality into drive and response powers, caused by weight drop, which together outcome in the revolution of the turbine shaft or rotor.[15] The edges in the high-weight (HP) and Intermediate weight (IP) turbine are little and medium in light of the low volumetric steam stream. Fundamental elements of the short, sharp edges run of the mill of HP turbines are recognised.

RELATED WORK

- The point by point examination made over the distinctive turbine cutting-edge materials of motivation

turbine keeping in mind the end goal to decrease the distortion happened on a sharp edge. So limited component stress, strain and the warm investigation have been done on two distinct materials of drive turbine cutting edge. It is a point of the examination to think about how well the cutting edges bolster the powers applied to them.

- In this paper a deliberate way to deal with the improvement of two-dimensional edge profiles is introduced. A hereditary enhancer has been created that adjusts the sharp edge profile and ascertains its profile misfortune. This procedure is programmed, creating profile plans substantially quicker and with altogether bring down trouble than has beforehand been conceivable.

- This paper examines a way to deal with the displaying and execution for the previous outline period of an extensive (6.2 MW) level hub wind turbine generator (WTG). Two control theories are displayed, both of which depend on linearised models of the WT mechanical and electrical frameworks. The control outlines are thought about by demonstrating the execution through itemised non-straight time reenactment. The aggravations considered are wind blasts, and electrical blames close to the WT terminals.

- There are numerous stochastic parameters to have an impact on the consistent quality of steam turbine cutting edge in functional operation. In a request to enhance the dependability of sharp edge design, these stochastic parameters are essential to be taken into account.In this paper, a meet cross-segment edge is researched, and a limited component show is assembled parametrically.Geometrical parameters, material parameters and load parameters of the side are considered as arbitrary information factors while the most extreme avoidance and greatest proportionate anxiety are yield irregular factors.

- The last stage turbine sharp edges disappointment was knowledgeable about two units of 660 MW. These groups have one high-weight turbine and two couple compound low-weight turbines with 44-in. Last-Arrange edges. The edges that fizzled were in a low weight (LP) turbine associated with the high weight turbine (LP1) and in LP turbine associated with the generator (LP2). The fizzled sharp edges had split in their underlying foundations starting at the trailing edge, curved side of the steeple peripheral filet sweep. Research facility assessment of the splitting demonstrates the disappointment component to be great cycle weakness (HCF).

FEA ANALYSIS OF STEAM TURBINE BLADE

The FE investigation aimed to decide the anxiety and Fatigue life of the parts in the primary area of the sharp edge. It has been discovered that the prime area of the sharp edge is arranged at the T foundation of the cutting edge. All the more decisively, at the raised side of the neck. Be that as it may, it is required to evaluate the exhaustion life of the entire sharp edge plate association. With the end goal of straightforward comprehending and arrangement time in ANSYS, the 3D model of cutting edge is disentangled by evacuating the join on the sharp side.

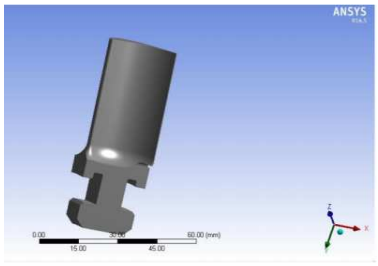

Figure 1: 3D Model of the Steam Turbine Blade

Meshing

Mesh generation is the practice of generating a polygonal or polyhedral mesh that approximates a geometric domain. The term "grid generation" is often used interchangeably. Typical uses are for rendering to a computer screen or for physical simulation such as finite element analysis or computational fluid dynamics.

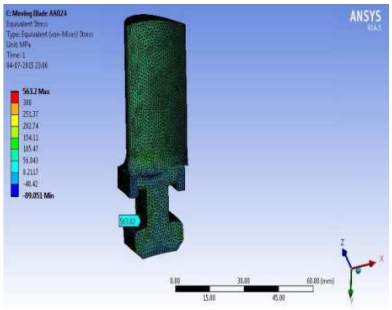

Figure 2: Fine Meshing of the Model

RESULT AND DISCUSSIONS

Fatigue Life for edge

Fatigue is the failure under repeated or otherwise varying load which never reaches a level sufficient to cause failure in a single application. Component seems to lose strength after multiple load applications, appears to get tired, hence the name "fatigue".

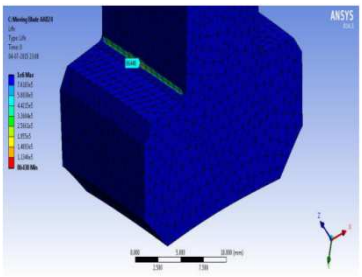

Figure 3: Analysis Result for Fatigue Life for Edge

Equivalent Stress

Equivalent stress also is known as the scalar-energy theory or the maximum distortion energy theory. The approach. States that a ductile material starts to yield at a location when the von Mises stress becomes. Equal to the stress limit. In most cases, the yield strength is used as the stress limit.

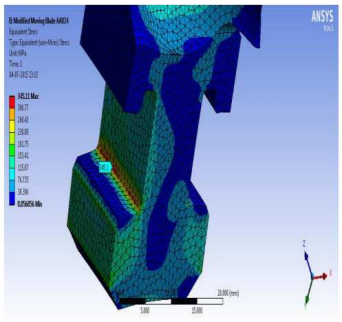

Figure 4: Analysis Result for Equivalent Stress

Fatigue Life

A finite element analysis (FEA) is carried out to find local regions of high stress under operating conditions. The maximum and minimum pressures under cyclic loading are considered. The number of stress cycles, together with the stress amplitude, dictates the fatigue life of the structure.

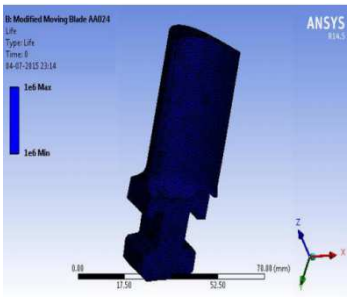

Figure 5: Analysis Result for Fatigue Life

CONCLUSIONS

This venture has endeavoured to explore the weakness reaction of the steam turbine sharp edge as far as high cycle exhaustion. Existing cutting edge configuration is adequate for weakness life in hypothetical estimation. Be that as it may, there is an issue in the limited component examination. In theoretical figuring cutting-edge model is getting a limitless life (3.438e6). Be that as it may, amid keep running of ANSYS programming existing edge configuration is getting just 96436 is some cycles as exhaustion life. A few alterations are recommended to the steam turbine cutting-edge architect who can accomplish the life of 1e06 cycles as weariness life.

REFERENCES

1. *BALAJI, V. J., AROCKIYADASS, B., ABRAHAM, R., & SHAJI, B. DESIGN AND ANALYSIS OF STEAM TURBINE BLADE. INTERNATIONAL JOURNAL OF NANO CORROSION SCIENCE AND ENGINEERING, 108.*
2. *Trigg, M. A., Tubby, G. R., & Sheard, A. G. (1999). An automatic genetic optimisation approach to two-dimensional blade profile design for steam turbines. Journal of turbomachinery, 121(1), 11-17.*
3. *Murdoch, A., Winkelman, J. R., Javid, S. H., & Barton, R. S. (1983). Control design and performance analysis of a 6 MW wind turbine-generator. IEEE transactions on power apparatus and systems, (5), 1340-1347.*
4. *Chilakala venkatareddy,Munaganuri Anil Kumar & Junaid Farooq, Hysteresis Damping in a Steam Turbine Blade by Using ANSYS and Hypermesh, International Journal of Mechanical and Production Engineering*

Research and Development (IJMPERD), Volume 3, Issue 1,January - March 2013, pp. 181-188

5. *Duan, W., & Wang, Z. Q. (2007, February). Probability strength design of steam turbine blade and sensitivity analysis concerning random parameters based on response surface method. In Zhongguo Dianji Gongcheng Xuebao(Proceedings of the Chinese Society of Electrical Engineering) (Vol. 27, No. 5, pp. 99-104).*
6. *Mazur, Z., Garcia-Illescas, R., Aguirre-Romano, J., & Perez-Rodriguez, N. (2008). Steam turbine blade failure analysis. Engineering Failure Analysis, 15(1), 129-141.*
7. *Kim, J. H., Kim, T. S., Sohn, J. L., & Ro, S. T. (2002, January). Comparative analysis of off-design performance characteristics of single and two shaft industrial gas turbines. In ASME Turbo Expo 2002: Power for Land, Sea, and Air (pp. 509-516). American Society of Mechanical Engineers.*
8. *He, L. (1997). Computation of unsteady flow through steam turbine blade rows at partial admission. Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy, 211(3), 197-205.*
9. *Patel, M. R. (2005). Wind and solar power systems: design, analysis, and operation. CRC press.*
10. *Richter, C. H. (2003). The structural design of modern steam turbine blades using ADINA ™. Computers & Structures, 81(8), 919-927.*
11. *Fréchette, L. G., Lee, C., Arslan, S., & Liu, Y. C. (2003, November). Design of a microfabricated Rankine cycle steam turbine for power generation. In Proc. ASME International Mechanical Engineering Congress (pp. 15-21).*
12. *Denton, J. D., & Dawes, W. N. (1998). Computational fluid dynamics for turbomachinery design. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 213(2), 107-124.*
13. *Kim, T. S. (2004). Comparative analysis on the part load performance of combined cycle plants considering design performance and power control strategy. Energy, 29(1), 71-85.*
14. *Rice, I. G. (1993, May). Steam-Injected Gas Turbine Analysis—Part I—Steam Rates. In Proceedings of the International Gas Turbine and Aeroengine Congress and Exposition, Cincinnati, OH, USA (Vol. 2427).*
15. *Bunker, R. S. (2006). Axial turbine blade tips: function, design, and durability. Journal of Propulsion and Power, 22(2), 271-285.*
16. *Deyuan, L., Zhiquan, Y., Nengsheng, B., & Yan, C. (2004). Vibration modal analysis of the rotating rotor of the horizontal axis wind turbine. Acta Energiae Solaris Sinica, 25, 72-77.*
17. *R. Madhusudhanan, A. Arun. Novel Architecture Based DWT with Folded and Pipelined Schemes for Infrasound Signal Classification. International Journal of MC Square Scientific Research (IJMSR). 2009; 1(1):1-8.*